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Heat-curable Shapable Compositions for the Production of Friction Bodies

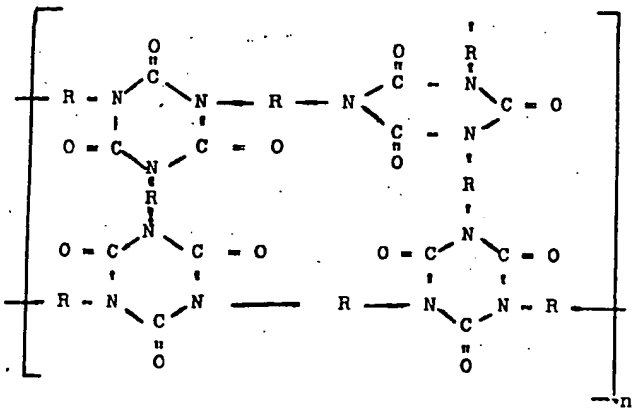
Addition to Patent ..... (Patent application P 17 27 255.0-43)

The main patent relates to heat-curable compressible compositions for the production of friction bodies, consisting of fillers serving as friction carriers and additives promoting the friction and/or slide properties, as well as organic binders on the basis of plastic phenolic resins which, in addition, contain an isocyanate compound prepolymerised with a trimerization catalyst in a proportion between this isocyanate trimerization compound to plastic phenolic resin between 1:1 and 1:10. A friction material which contains such compressible compositions according to the main patent, as compared to known friction materials of this kind, has excellent heat resistance, wear and elasticity properties and exhibits an improved, i.e. reduced attack on the counter-friction surface. The particular heat resistance and wear resistance which are exhibited by the friction materials contained in the compression moulding composition of the main patent are presumably due to the fact that the trimerization products contained in the finished friction layer undergo a decomposition in operation, i.e. at the high temperatures of more than about 300°C produced at the friction surface, with the formation of polycarbodiimide which reacts with the reactive compounds present in the friction material.

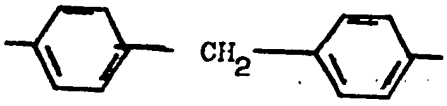
It has now been found that a further improvement, in particular with respect to a good wear resistance and a smaller attack on the counter-friction surface, in particular under relatively high surface pressures, may be achieved if the proportion of the isocyanate-trimerization compound in the compression moulding composition according to the main patent is reduced, and is preferable between about 1:20 and 1:50.

Accordingly, the invention relates to heat-curable compression moulding compositions for the production of friction bodies consisting of fillers serving as friction carriers and additives improving the friction and/or sliding properties, as well as organic binders on the basis of plastic phenolic resins and are isocyanate compound pre-polymerised with a trimerization catalyst, according to patent ..... (patent application P 19 27 255.0-43) which is characterised in that the proportion between isocyanate-trimerisation compound to plastic phenolic resin is between 1:10 and 1:70.

As already disclosed in the main patent, a friction material has been found particularly advantageous which contains compression moulding compositions of the stated type with a trimerization product of diphenylmethane diisocyanate as isocyanate compound present therein, pre-polymerised with 2,4,6-tris-(dimethylaminoethyl) phenol as catalyst. It has been found that the structure of this trimerization product can be adequately reproduced by the following formula:



wherein R is



The pre-polymerised isocyanate is a polyisocyanurate.

As plastic phenolic resins which form the binder component in the inventive friction material, the plastic phenolic resins already referred to in the main patent which are obtainable by a condensation reaction between formaldehyde and a phenol, both novolaks and resols, resitols oder resites may be used. Likewise, the fillers serving as friction carriers and the additives promoting the friction and/or sliding properties contained in the friction material according to the invention, are not different from the substances known for these purposes; therefore, no particular reference thereto will be made in the present connection.

The preparation of the friction materials according to the invention takes place in substantially the same manner as that of the known friction materials. Thus, the components may be mixed in usual mixing devices, subsequently compressed under pressures between about 100 and 800 kp/cm² or in a hot state (at temperatures between about 80 - 200°C) and subsequently cured at temperatures between about 80 and 300°C for several hours, preferably about 8 to 12 hours. After the curing and cooling, the friction materials are usable.

The friction materials according to the invention may, however, also be produced by impregnating fibrous materials with solutions or suspensions of the binders and additives according to the invention.

In the following examples, several exemplary compositions disclosing the friction material according to the invention are

described in detail, and their test data are presented and compared with those of the friction materials according to the main patent. The percentages and other proportions are understood as percents by weight and parts by weight.

Example 1 (Comparison Sample)

A friction material was made from the following components:

Phenol formaldehyde condensation product		90 parts
Mineral friction promotors	(asbestos and metal oxides)	300 parts
Organic friction promoters	(dead-burned duroplast resins and mineral pigments[+])	100 parts

[+] Commercial product sold under the trade name "friction dust" by BP.

The components were mixed dry in the usual manner and subsequently compressed in the desired mould under a pressure of 600 kp/cm², thereafter taken out of the mould and cured, the curing temperature being increased to 190°C as the final temperature during about 10 hours. The final temperature was maintained for 5 hours. Products with the properties stated in the following table were obtained.

Example 2 (Product According to the Invention)

A friction material was made from the following components:

Phenol formaldehyde condensation product		90 parts
Mineral friction promotors	(as in Example 1)	300 parts
Organic friction promoters	(as in Example 1)	100 parts
Trimerization product[++]		7.2 parts

[++] The trimerization product was the reaction product of diphenylmethane-4,4'-diisocyanate trimerized with a mixture of tertiary phenolic amines.

The components were mixed as described in Example 1, compressed and cured. The final temperature was maintained for 5 hours. The curing took place without difficulties. Products having the properties given in the following Table were obtained.

The tests were carried out on a partial layer test stand with a counter material GGL 25 (grey cast iron L 25). The sample sizes were 2 cm^2. The test conditions were as follows:

Braking time	5 min
Surface compression	12.5 kp/cm^2
Velocity	12 m/sec

The following test data are average values from several measurements.

Temperature of the counter-material	Abrasion in g/KWh (braking efficiency)	
	Product acc. to Example 1	Product acc. to Example 2
100°C	0.5	0.4
250°C	1.7	1.2
400°C	4.0	2.8

These numerical data illustrate that, in particular at high temperatures, the friction material according to the invention has a substantially smaller abrasion, as compared to the comparative material.

CLAIM

Curable compression moulding composition for the production of friction bodies, consisting of fillers serving as friction carriers and additives promoting the friction and/or sliding properties, as well as organic binders on the basis of plastic phenolic resins, which, in addition, contains an isocyanate compound, pre-polymerised with a trimerisation catalyst according to patent ..... (patent application P 19 27 255.0-43), characterised in that the proportion of polyisocyanurate-trimerisation compound and plastic phenolic resin is between 1:10 and 1:70, preferably between 1:20 and 1:50.